A Philosophical Investigation into the Nature of Time & Time Measurement

"What then is time? If no one asks me, I know what it is. If I wish to explain it to him who asks, I don't know"

Saint Augustine (Confessions, Book 11)

Introduction:

Time has an enigmatic nature. Our everyday life is a continuous encounter with the flow of time. Unlike physical perceptions, time does not have any of our five senses assign to it. Our primary sensory mechanism, sight helps us to see a 3-Dimensional world around us. Although there are no sensory organs present in the human body that directly perceives time but the sense of time is a fundamental mechanism that happens in all the cells at the genetic level of a living organism. Now, the question is where does this sense come from? What is the origin of this sense of time that permeates all our physical sciences and plays a crucial role in every single conscious action and decision we make in our lives. It is important to know what is time in the natural world because this question is also very much related to the origin of the universe. Different people in different disciplines are just trying to solve out one problem, the mystery of the universe. What was the beginning of this universe and how it will come to an end? To get this answer one must have to find out the true nature of time.

The very first thing we commonly observe about the nature of time is that time is cyclic, sequential and sustainable in the sense that time is perceived as a sequence of events which happens in a sustainable and cyclic manner. But to understand the cyclic nature of time we need to have a memory of the events in sequence. For example: sun rises in the first day and sets in the same day and again rises in the second day which can only be differentiated if and only if there is a memory of the previous day. Thus we can say, to count the number of cycles, we need memory that registers the events of the present. Perhaps for this reason the babies cannot remember the earlier years of their life. They can count the number of days, which class they are studying etc when they have more accurate and detailed perception of time.

Surprisingly perception of time gives us some important clues about the nature of time. We perceive time as cyclic. Every day the sun rises, changing its position time to time and then it gets dark…Soon the day passes away with the beginning of another day. In this way month changes, season changes with the change in year. Besides the perception of time as a circle, there is a concept of time line also. It's very interesting that our own internal understanding of time is really a never ending present. In this time, the end is not the beginning. My senses detect a change of state of my environment. My environment is ever changing. My mind can remember a state when things were different. My mind can only detect time based on environmental changes. The time line is the time of my mind. Time circle is the time of clocks.

So our perception tells us that time is cyclic and at the same time it flows in one direction and it cannot be reversed. But history taught us that intuitive conclusions based on immediate perceptions are not always to be trusted, for they sometimes lead to the wrong ways. Today's Physicists understand time in a particular way which generally does not incorporate the passage of time. Physicists observe time as a fourth dimension in addition to three spatial dimension. Thus, physicists' understanding of time is determined by their understanding of reality. In this connection I would like to mention Albert Einstein's name. Today's latest and most significant theory of time is 'The Special Theory of Relativity' proposed by him. Before Einstein, both Newton and Galileo, as well as most physicists until 20th century thought that time was same for every one everywhere. In other words for every observer the time flows equably. But Einstein had revolutionized this notion of objective time. He said that time does not lapse uniformly for all observers. Time is not absolute. It is relative. Now the problem is Einstein was a realist. As he put it, "Reality is the business of physics". According to Einstein, the whole purpose of science is to get behind the phenomena of experimental data and their mathematical description to the real world that underlies them. He believed, to the end, that the goal of science was to discover the way the world really is as opposed to our perceptions and conceptions of it. For Einstein, time is relative yet real thing. Now this is a bit confusing concept. What Einstein discovered was something which for most of us is beyond perception.

Aim of the Research:-

So on the quest of ascertaining the nature of time and reality; I would like to focus on two topics mainly, The metaphysics of time and the various method of time measurement

(whether it is ancient or modern) in my research. Notion of time measurement is inextricably associated with the nature of time. For serving these two purposes I want to examine some Vedic and Post Vedic philosophical texts on time and the Einstenian philosophical and scientific view on time in modern physics. In this point an obvious question arises that why these two different domains have been chosen and how they will help me out to achieve my desired research aim?

To get the answer we need to look for some references. We all know that Vedic and post Vedic Indian philosophical schools contain a vast source of knowledge and have been guiding Indian civilisation for thousands of years. There are wide ranges of discussion regarding time in Indian philosophy. Let's take a quick look to some of the references.

In Atharva Veda there are fifteen sutras dealing with time or Kāla. The hymn named as kālasūktam (book19, hymn 53), provides us the idea about the nature of time in Ancient India where time is personified as a primordial power and a powerful deity and also the creator, sustainers and destroyer of the universe. Atharva Vedic sages stated about the nature of time. They have used various analogous terms to define time. Like they describe (hymn 51.1) time as a horse/ashwa which flows continuously with seven rays and thousands of axes. Time does not get tired any time because it has tremendous force or energy. The wise people think on the Time again and again and try to ride over it. The wheels of the Time are the worlds (Bhuwanani) and the Galaxies (Vishwa). Ashwa is a special noun which has two components A + Shwa. It means the Time has no (A) tomorrow (Shwa). This means the Time has no future. The statement of the sage is really true because the time is continuous and therefore it has neither yesterday nor tomorrow. Time has no past and no future.

The Sūrya Sidhhānta is one of the oldest treatises in Hindu astronomy. The first chapter of Sūrya Siddhānta is "Time and its measurement". It has been told there that there are two kinds of time. One is the creator and destroyer of all things. The second is the time that we observe. Observable time is again of two kinds, what can be measured (Mūrta) and what cannot be measured (Amūrta) either because it is too small or because it is too big. Amūrta begins with a Truti. Mūrta begins with a Prāṇa. 6 Pranas is a Pala. 60 Palas is a Ghatika and so on. In surya sidhhanta we can see they have mentioned four types of year. These are nakshatra year, lunar year, savana year and solar year. Time is measured in years and subdivision of years. Years are divided in months, months are divided in days. Days are divided in smaller portion. Every year has 12 months and 30 days in each month. Thus every

year has 360 days. It has been told there that nakshatra day is the time it takes for all nakshatras to revolve around the earth one time. Now think about it, we all know that does not really happen. The stars are out there surrounding us. In one day the earth is spinning around on its axis once. For this reason, from our point of view, we observe that the nakshatras are spinning around the earth. So, one revolution of the earth on its axis is one nakshatra day.

The Bhāgavata Purāna is considerd to be the purest and greatest of all the purānas . In the eleventh chapter of Bhāgavata Purāna there is a conversation between Maitreya and Vidur where we can find a very accurate measurement of time. It is written over there that the smallest particle of material substance, which has not yet combined with any other similar particles, is called paramānu. A combination of two paramānus make an Anu .Three atoms make a Thrasarenu. A combination of thresranu's are said to be visible through the sun rays through a window. Paramānu as a source and basic unit of time calculated as the time sunrays take to pass through them. The time taken by the combination of three *trasarenus* is called a *truthi* . A combination of 100 thruthis is called a vedha and three Vedas together were called as a lava and so on.

The Viṣṇu Purāna was taught by rishi Parasara to Maitreya rshi at his request as that Purāna which would grant him all knowledge of events past and future as well as dharma. In Viṣṇu Purāna (section 4,chapter 1) there is a indication of time dilation theory in form of a story. The story of Revathi.

Mahābhārata, as we all know, one of the two epic poems of Ancient India. Mahābhārata is a very important and valuable book of ancient Sanskrit literature. Kāla (the time) has been described in so many references of this book. The Upakramanika Adhyāya or introductory chapter of the Ādi Parva of the Mahābhārata, which is generally regarded as the oldest part of the epic, opens up with a philosophical discourse on cosmic time.

From the above mentioned references it can be inferred that ancient Indians had tried to figure out the true notion of time and also had developed an accurate time measurement process. If we observe their measurement of time it will be clear to us that step by step they had reached the level of accuracy. They had used different parameter to measure the time. The different parameters are the rising and setting of the sun; moon; stars, waxing and waning moon, the tides, the seasons, the relative motion of the luminaries (nakshtram & grahas). All these are natural clocks as all these things happen with a regularity and

repeatability. The sun will rise again tomorrow, it will rain again next year, the moon shall yet again become full, the grahas and nakshatras shall once again attain their present relative positions. They wanted to improve the accuracy of measurement to the minute level. For this reason they had used some other parameters in their time. One of them was nimesha. This is mentioned in bhagavata purana as the time taken to the blinking of a human eye. Finally with the urge to reach highest level of accuracy of measuring time they had introduced the concept of paramanu because paramanu is the smallest particle of material substance which had not yet combined with any other particles. So they had started their counting of time from a very basic level, which is only theoretically conceivable. This kind of fundamental thinking often leads to particular discoveries or inventions. Ancient Indians devised sun dial, ghatika yantra for measuring time. We can say that they had some techno-scientific potential in them. Indian time measurement system is considered to be the oldest time measurement system. So, it is very much necessary for us to interpret our classical Indian views on time from a modern mental frame work to grasp their ideas and thought process which is much enriched in nature.

Besides this we are now in the age of science. There has been considerable advancement in modern scientific theories which are worth appreciating. After the development of the theories like relativity and quantum mechanics in contemporary Physics, the notion of time underwent several modifications. Physicists observe time as a fourth dimension in addition to three spatial dimension. The latest and most significant theory of time i.e.'The Special Theory of Relativity', proposed by the Jewish physicist, Albert Einstein in the early part of 20th century. Before Einstein, both Newton and Galileo, as well as most physicists until 20th century thought that time was same for every one everywhere. In other words for every observer the time flows equably. But Einstein has revolutionized this notion of objective time. He said that time does not lapse uniformly for all observers. Time is not absolute. The theory of relativity based on two principles. The first principle is that there is no such thing as absolute motion or absolute rest. Objects move relative to each other. So if you have two objects and nothing else then it is not possible to tell which object is moving and which object is standing still. This is true also if one of the object is in entire planet. The second principle we need to accept that the speed of light is same for all observers. Let's imagine a man in the spaceship (observer A) is moving at a constant speed. From the perspective of A in the spaceship, the spaceship is standing still and it is planet which is moving. There is no experiment A can perform to let him know if he is moving. For example, if he throws a ball up in the air it will go straight up and down just as if he was standing still. Now imagine a

man (observer B) is standing on the earth and watching the spaceship is moving. From the perspective of observer B, the ball is already moving with the spaceship and the ball keeps its forward momentum when A throws it up in the air. So the fact is Observer A's view that the spaceship is standing still is just as valid as observer B's view that it is the planet which is standing still. But if we go for the third observer, it is the sun which is standing still and both the spaceship and planet are moving around it. From the perspective of a fourth observer, the sun is moving at a great speed along with the planet and spaceship. In general any observer can believe that they are standing still and that the rest of the planet is moving. This theory is applicable to the objects which are moving in the same direction in same speed and there is no acceleration.

The second principal that Einstein's theory of relativity is based on is that the speed of light in a vacuum is same for all observers. Suppose observer 'A' fires a laser from the spaceship at the ground which bounces off a mirror and observer 'A' measures the time it takes for the light to return to spaceship. From A's perspective laser light goes straight up and down. From B's perspective the laser light follows a 'V' shape path (because he is watching from the ground and the ship is moving). The 'V' shape path is longer than the straight up and down path. Since, the speed of light is same for all observers, from B's perspective it takes a longer amount of time for the laser light to return to the spaceship. Now if observer B looks at A's clock, he will see that A's clock read less time when he fires the laser and when he receives the reflected light back. This implies that the observer 'B' will observe observer A's clock running slower than his own clock. The closer that a spaceship approaches the speed of light, the slower the time inside the ship will lapse. If the speed of the spaceship is equal to the speed of light, then time inside the ship would stop altogether. However, no matter how fast the spaceship travels, 'A' will never notice that time is going slower So, for observer 'A' time appears to be lapsing normally. There comes the famous equation of Einstein that $E= mc^2$. Here 'E' stands for energy, m= mass and c= the speed of light. It means that as an object moves with more energy, its mass increases. This is why nothing can travel faster than speed of light. As an object gets close to the speed of light it becomes so big that an infinite amount of energy would be required to move it faster.

Theories of relativity include many more complex concepts. But to avoid the unnecessary difficulties, for now, I have mentioned its simplified explanations just to give a basic view. Further deeper studies are needed to grasp the whole thing.

The objective of incorporating these two views on the nature of time in the present study is to see whether, despite fundamental philosophical differences, these distinct approaches can mutually benefit each other or not? By examining these different standpoints on the problem concerning the (metaphysical) nature of time, we intend to develop a more comprehensive, critical-philosophical account of time than is available in the contemporary philosophical literature.

Literature Survey:-

In my research I have taken materials from some texts namely Hymns of AtharvaVeda by Maurice Bloomfield, A Brief History Of Time by Stephen Hawkings, 'Measurement Of Time' by B.A Kagali and M.Y Anand, The Fabric of the Cosmos by Brian Greene , A study of time in Indian philosophy by Anindita Niyogi Balslev ,The Evolution of Physics by Albert Einstein and Leopold Infeld, Albert Einstein philosopher scientist by Paul Arthur Schilpp, The telling of time in Ancient India by F.E.Pargiter, Clocks-Ancient and Modern by W.S Eicheberger, Kala, the Time By P.V. Vartak, The Elegant Universe by Brian Green.

In my PhD work I would like to include more extensive ideas in the investigation on the nature time from Indian and western philosophy. Here are the tentative Chapter division-

Chapter Division:-

Introduction

Chapter 1 : 'Temorality' as found in classical Indian literature

Section 1:- Concept of time in Atharva Veda.

Section 2:- Measurement of time in SuryaSiddhanta.

Section 3:- Notion of time in Sattvic Purana.

Chapter 2 :- **A overall view of Time in Indian Philosophy**

Section 1:- On the reality of absolute time- Nyaya Vaisesika View

Section 2:- Time in Buddhism

Section 3:- Notion of time in Sankhya Yoga

Section 4:- Notion of time in Advaita Vedanta

Chapter 3:- Time measurement process

Chapter 3:- **Time measurement process**

Section 1:- Various astronomical instrument of Ancient India

Section2:- An evolution of measuring apparatus of time till Contemporary period

Chapter 4:- **Modern scientific views of time and temporal measurement**

Section1:-Einstein's view on time: Theory of special & general relativity

Chapter 5:- A comparative note on the notion of time

Conclusion:

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